

# PRELIMINARY

## NEC NEC LCD Technologies, Ltd.

### TFT COLOR LCD MODULE

**NL8060BC31-50F**

**31cm (12.1 Type)  
SVGA**

### PRELIMINARY DATA SHEET

**DOD-PP-0991 (1st edition)**

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Please confirm the sales representative before  
starting to design your system.**

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Examples: Military systems, aircraft control equipment, aerospace equipment, nuclear reactor control systems, medical equipment/devices/systems for life support, etc.

The quality grade of this product is the "**Standard**" unless otherwise specified in this document.

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## 1. OUTLINE

### 1.1 STRUCTURE AND PRINCIPLE

Color LCD module NL8060BC31-50F are composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight.

The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

### 1.2 APPLICATION

- For industrial use

### 1.3 FEATURES

- Long life LED backlight type
- High luminance
- High contrast
- Wide viewing angle
- Wide temperature range
- 6-bit digital RGB signals
- Reversible-scan direction
- Replaceable lamp holder for backlight

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## 2. GENERAL SPECIFICATIONS

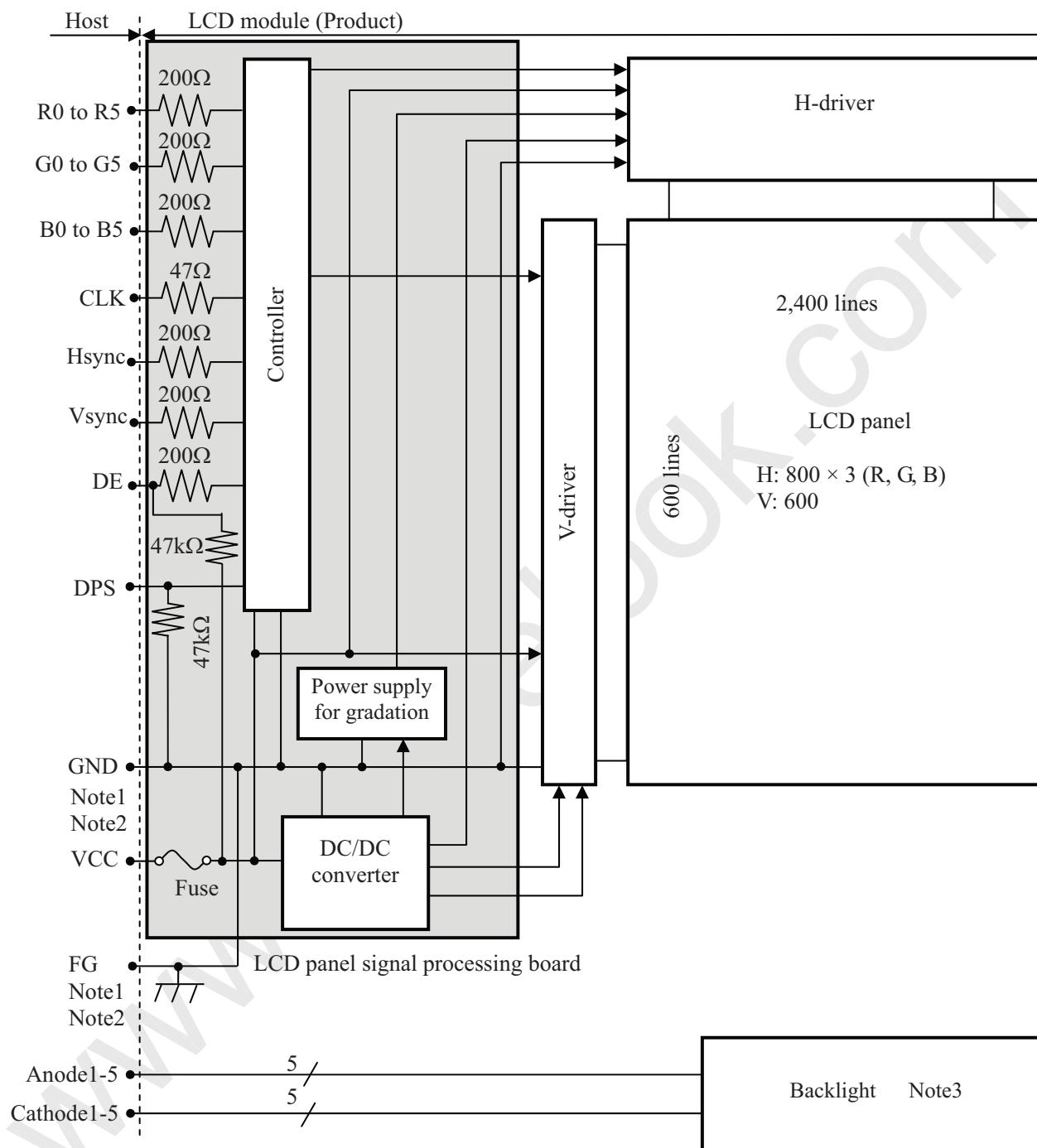
<b>Display area</b>	246.0 (H) × 184.5 (V) mm
<b>Diagonal size of display</b>	31cm (12.1 inches)
<b>Drive system</b>	a-Si TFT active matrix
<b>Display color</b>	262,144 colors
<b>Pixel</b>	800 (H) × 600 (V) pixels
<b>Pixel arrangement</b>	RGB (Red dot, Green dot, Blue dot) vertical stripe
<b>Dot pitch</b>	0.1025 (H) × 0.3075 (V) mm
<b>Pixel pitch</b>	0.3075 (H) × 0.3075 (V) mm
<b>Module size</b>	260.5 (W) × 203.0 (H) × 8.7 (D) mm (typ.)
<b>Weight</b>	490 g (typ.)
<b>Contrast ratio</b>	800:1 (typ.)
<b>Viewing angle</b>	<p><i>At the contrast ratio ≥ 10:1</i></p> <ul style="list-style-type: none"> <li>Horizontal: Right side 80° (typ.), Left side 80° (typ.)</li> <li>Vertical: Up side 80° (typ.), Down side 80° (typ.)</li> </ul>
<b>Designed viewing direction</b>	<p><i>At DPS= Low or Open: Normal scan</i></p> <ul style="list-style-type: none"> <li>Viewing direction without image reversal: Up side (12 o'clock)</li> <li>Viewing direction with contrast peak: Down side (6 o'clock)</li> <li>Viewing angle with optimum grayscale (<math>\gamma=2.2</math>): Normal axis (perpendicular)</li> </ul>
<b>Polarizer surface</b>	Clear
<b>Polarizer pencil-hardness</b>	3H (min.) [by JIS K5400]
<b>Color gamut</b>	<p><i>At LCD panel center</i></p> <p>40 % (typ.) [against NTSC color space]</p>
<b>Response time</b>	<p><i>Ton + Toff (10% ↔ 90%)</i></p> <p>TBD ms (typ.)</p>
<b>Luminance</b>	<p><i>At IL = 50 mA/One circuit</i></p> <p>800 cd/m<sup>2</sup> (typ.)</p>
<b>Signal system</b>	6-bit digital signals for data of RGB colors, Dot clock (CLK), Data enable (DE), Horizontal synchronous signal (Hsync), Vertical synchronous signal (Vsync)
<b>Power supply voltage</b>	LCD panel signal processing board: 3.3V or 5.0V
<b>Backlight</b>	<p>LED backlight type:</p> <p>         Replaceable part          • Lamp holder set: Type No. TBD       </p> <p>         Recommended LED driver board (Option)          • LED driver board :Type No. TBD       </p>
<b>Power consumption</b>	<p><i>At IL = 50 mA/One circuit, Checkered flag pattern</i></p> <p>TBD W (typ.)</p>

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### 3. BLOCK DIAGRAM



Note1: Relations between GND (Signal ground), FG (Frame ground) in the LCD module are as follows.

GND - FG	Connected
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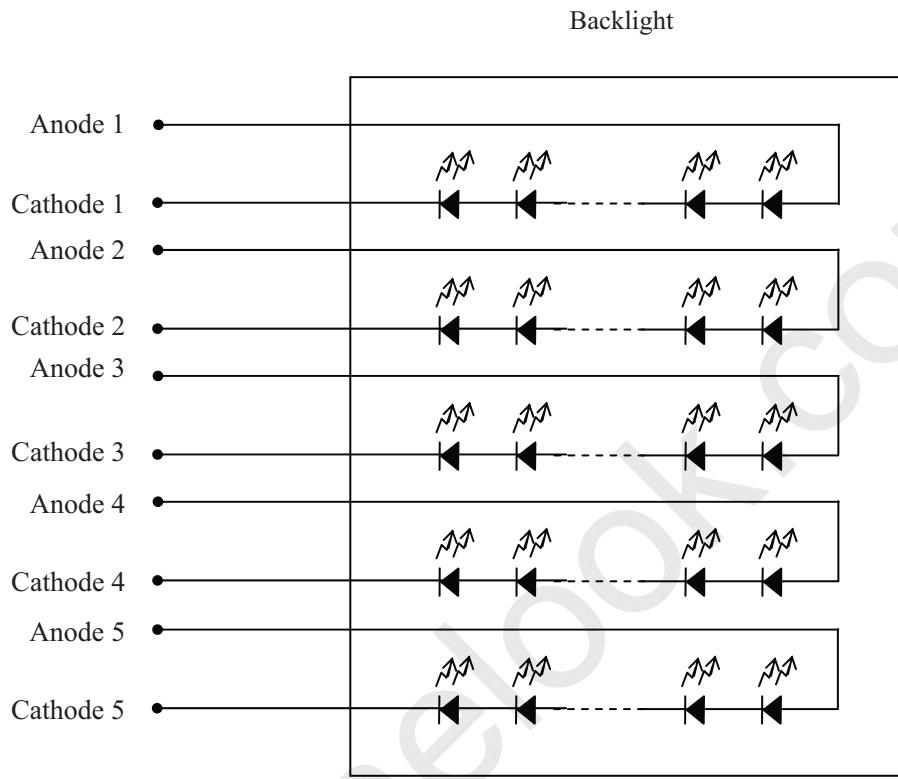
Note2: GND, FG and GNDB must be connected to customer equipment's ground, and it is recommended that these grounds be connected together in customer equipment.

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Note3: Backlight in detail



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## 4. DETAILED SPECIFICATIONS

### 4.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	260.5 ± 0.5 (W) × 203.0 ± 0.5 (H) × 8.7 ± 0.5 (D)	Note1
Display area	246.0 (H) × 184.5 (V)	Note1
Weight	490 (typ.), 540 (max.)	g

Note1: See "8. OUTLINE DRAWINGS".

### 4.2 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Remarks
Power supply voltage	VCC	-0.3 to +6.5	V	
Input voltage for signals	VD	-0.3 to VCC+0.3	V	Ta = 25°C
	VF			
Backlight	IL	TBD	mA	per one circuit
	VL	50	V	per one circuit
Storage temperature	Tst	-30 to +80	°C	-
Operating temperature	TopF	-30 to +80	°C	Note3
	TopR	-30 to +80	°C	Note4
Relative humidity Note5	RH	≤ 95	%	Ta ≤ 40°C
		≤ 85	%	40°C < Ta ≤ 50°C
		≤ 55	%	50°C < Ta ≤ 60°C
		≤ 36	%	60°C < Ta ≤ 70°C
Absolute humidity Note5	AH	≤ 70 Note6	g/m <sup>3</sup>	Ta > 70°C

Note1: CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)

Note2: DPS

Note3: Measured at center of LCD panel surface (including self-heat)

Note4: Measured at center of LCD module's rear shield surface (including self-heat)

Note5: No condensation

Note6: Water amount at Ta= 70°C and RH= 36%

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## 4.3 ELECTRICAL CHARACTERISTICS

## 4.3.1 LCD panel signal processing board

(Ta= 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage	VCC	3.0	3.3	3.6	V	at VCC= 3.3V
		4.75	5.0	5.25	V	at VCC= 5.0V
Power supply current	ICC	-	TBD Note1	TBD Note2	mA	at VCC= 3.3V
		-	TBD Note1	TBD Note2	mA	at VCC= 5.0V
Logic input voltage for display signals	High	VDH	0.7VCC	-	VCC	V
	Low	VDL	0	-	0.3VCC	V
Input voltage for DPS signal	High	VFH	0.7VCC	-	VCC	V
	Low	VFL	0	-	0.3VCC	V

Note1: Checkered flag pattern [by EIAJ ED-2522]

Note2: Pattern for maximum current

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## 4.3.2 Backlight lamp

(Ta= 25°C, Note1, Note2)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks
Forward current	IL	-	50.0	55.0	mA	-
Forward Voltage	VL	21.2	24.0	27.2	V	Ta= +25°C at IL= 50mA /One circuit
		19.28	-	-		Ta= +80°C at IL= 50mA /One circuit
		-	-	29.84		Ta= -30°C at IL= 50mA /One circuit
		-	-	30.56		Ta= -30°C at IL= 55mA /One circuit

Note1: Please drive with constant current.

Note2: The Luminance uniformity may be changed depending on the current variation between 5 circuits.  
It is recommended that the current value difference among the circuits be less than 5%.

## 4.3.3 Power supply voltage ripple

This product works if the ripple voltage levels are over the permissible values as the following table, but there might be noise on the display image.

Power supply voltage		Ripple voltage (Measure at input terminal of power supply)	Note1	Unit
VCC	3.3 V	$\leq 100$		mVp-p
	5.0 V	$\leq 100$		mVp-p

Note1: The permissible ripple voltage includes spike noise.

## 4.3.4 Fuse

Parameter	Fuse		Rating	Fusing current	Remarks
	Type	Supplier			
VCC	TBD	TBD	TBD	TBD	Note1
			TBD		

Note1: The power supply's rated current must be more than the fusing current. If it is less than the fusing current, the fuse may not blow in a short time, and then nasty smell, smoke and so on may occur.

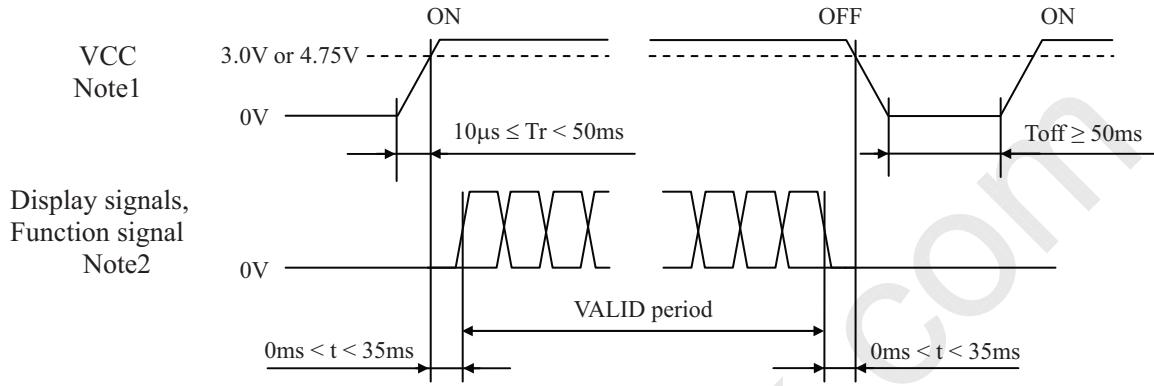
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## 4.4 POWER SUPPLY VOLTAGE SEQUENCE

### 4.4.1 LCD panel signal processing board

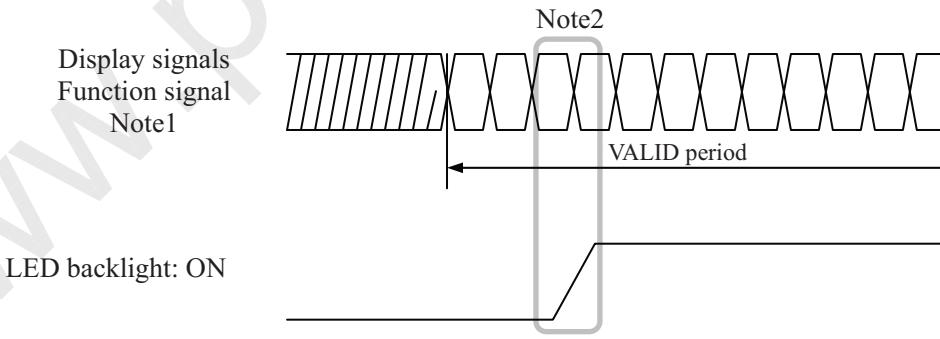


Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V in "VCC = 3.3V" or 4.75V in "VCC = 5.0V", there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (CLK, Hsync, Vsync, DE, DATA (R0 to R5, G0 to G5, B0 to B5)) and function signal (DPS) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.

If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VCC also must be shut down.

### 4.4.2 LED Driver board (Option)



Note1: These are the display and function signals for LCD panel signal processing board.

Note2: The backlight should be turned on within the valid period of display and function signals, in order to avoid unstable data display.

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## 4.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

### 4.5.1 LCD panel signal processing board

CN1 socket (LCD module side): DF9C-41P-1V (2\*) (Hirose Electric Co., Ltd. (HRS))

Adaptable plug: DF9-41S-1V (2\*), DF9-41S-1V (3\*) (Hirose Electric Co., Ltd. (HRS))

Pin No.	Symbol	Signal	Remarks
1	GND	Ground	Note1
2	CLK	Dot clock	-
3	GND	Ground	Note1
4	Hsync	Horizontal synchronous signal	
5	Vsync	Vertical synchronous signal	
6	GND	Ground	
7	GND	Ground	
8	GND	Ground	
9	R0	Red data (LSB)	Least significant bit
10	R1	Red data	
11	R2	Red data	
12	GND	Ground	Note1
13	R3	Red data	
14	R4	Red data	
15	R5	Red data (MSB)	Most significant bit
16	GND	Ground	
17	GND	Ground	
18	GND	Ground	
19	G0	Green data (LSB)	Least significant bit
20	G1	Green data	
21	G2	Green data	
22	GND	Ground	Note1
23	G3	Green data	
24	G4	Green data	
25	G5	Green data (MSB)	Most significant bit
26	GND	Ground	
27	GND	Ground	
28	GND	Ground	
29	B0	Blue data (LSB)	Least significant bit
30	B1	Blue data	
31	B2	Blue data	
32	GND	Ground	Note1
33	B3	Blue data	
34	B4	Blue data	
35	B5	Blue data (MSB)	Most significant bit
36	GND	Ground	Note1
37	DE	Selection of DE / Fixed mode	High or Open: Fixed mode Data enable signal: DE mode
38	N. C.	-	Keep this pin Open.
39	VCC	Power supply	
40	VCC	Power supply	
41	DPS	Selection of scan direction	High: Reverse scan Low or Open: Normal scan

Note1: All VCC and GND terminals should be used without any non-connected lines.

Note2: See "4.8 SCANNING DIRECTIONS".

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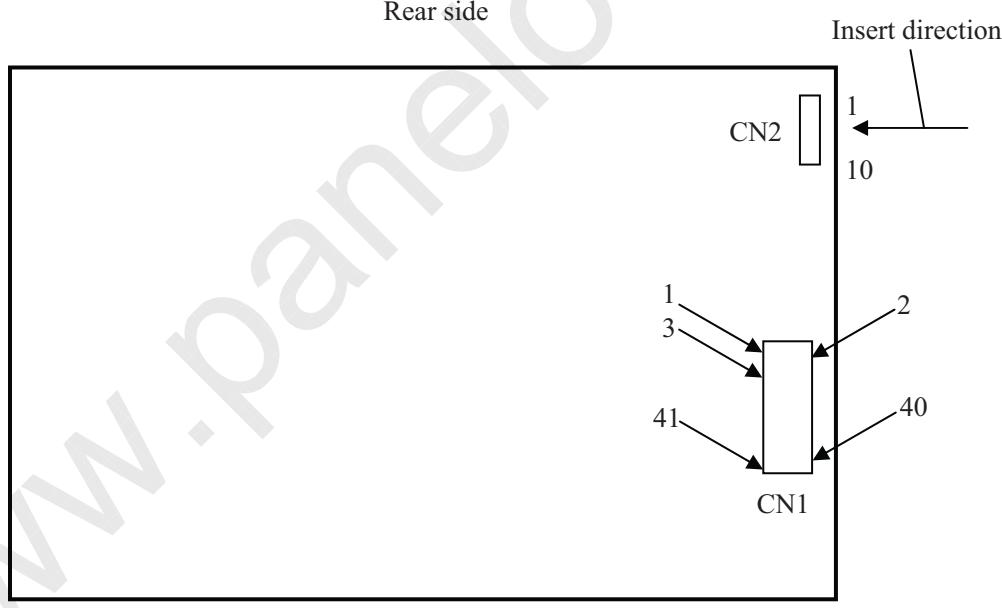
## 4.5.2 Backlight lamp

CN2 plug (LCD module side): SM10B-SRSS-TB (J.S.T. Mfg. Co., Ltd.)

Adaptable socket: SHR-10V-S, SHR-10V-S-B (J.S.T. Mfg. Co., Ltd.)

Pin No.	Symbol	Signal	Remarks
1	A1	Anode1	-
2	K1	Cathode1	-
3	A2	Anode2	-
4	K2	Cathode2	-
5	A3	Anode3	-
6	K3	Cathode3	-
7	A4	Anode4	-
8	K4	Cathode4	-
9	A5	Anode5	-
10	K5	Cathode5	-

## 4.5.3 Positions of plug and socket



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## 4.6 DISPLAY COLORS AND INPUT DATA SIGNALS

This product can display 262,144 colors with 64 gray scales. Also the relation between display colors and input data signals is as follows.

Display colors		Data signal (0: Low level, 1: High level)																
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1
Basic colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	↑	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	↓	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	↑	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	↓	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	bright	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0
	Green	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0
Blue gray scale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	↑	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0
	↓	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	0
	bright	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1

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## 4.7 DISPLAY POSITIONS

The following table is the coordinates per pixel (See "4.8 SCANNING DIRECTIONS").

C (0, 0)						
R	G	B				
C( 0, 0)	C( 1, 0)	•••	C( X, 0)	•••	C(798, 0)	C(799, 0)
C( 0, 1)	C( 1, 1)	•••	C( X, 1)	•••	C(798, 1)	C(799, 1)
•	•	•	•	•	•	•
•	•	•••	•	•••	•	•••
•	•	•	•	•	•	•
C( 0, Y)	C( 1, Y)	•••	C( X, Y)	•••	C(798, Y)	C(799, Y)
•	•	•	•	•	•	•
•	•	•••	•	•••	•	•
•	•	•	•	•	•	•
C( 0, 598)	C( 1, 598)	•••	C( X, 598)	•••	C(798, 598)	C(799, 598)
C( 0, 599)	C( 1, 599)	•••	C( X, 599)	•••	C(798, 599)	C(799, 599)

## 4.8 SCANNING DIRECTIONS

The following figures are seen from a front view. Also the arrow shows the direction of scan.

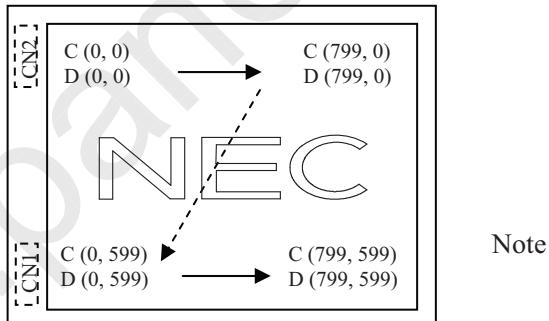


Figure1. Normal scan (DPS: Low or Open)

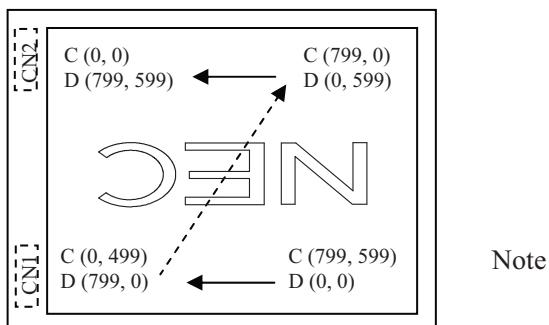


Figure2. Reverse scan (DPS: High)

Note1: Meaning of C (X, Y) and D (X, Y)

C (X, Y): The coordinates of the display position (See "4.7 DISPLAY POSITIONS").

D (X, Y): The data number of input signal for LCD panel signal processing board

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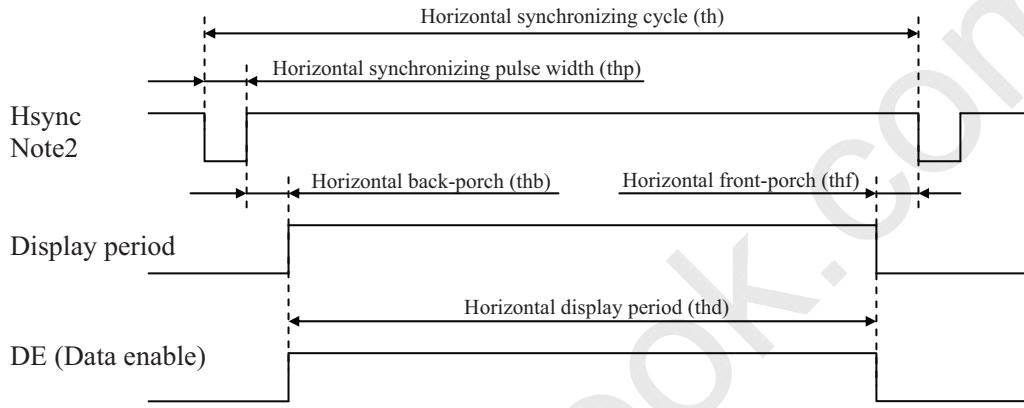
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## 4.9 INPUT SIGNAL TIMINGS

### 4.9.1 Outline of input signal timings

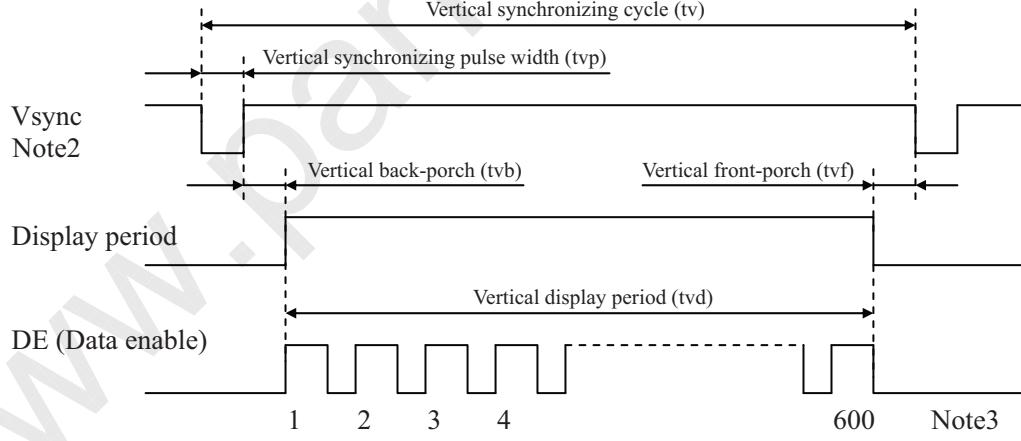
- Horizontal signal

Note1



- Vertical signal

Note1



Note1: This diagram indicates virtual signal for set up to timing.

Note2: Fixed mode cannot be used while working of DE mode.

Note3: See "4.9.3 Input signal timing chart" for the pulse number.

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## 4.9.2 Timing characteristics

## (a) Fixed mode

(Note1)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/tc	34.0	38.362	42.0	MHz	26.067 ns (typ.)	
	Duty	tcd	0.4	0.5	0.6	-		
	Rise time, Fall time	tcrf	-	-	10	ns		
DATA (R0-R5) (G0-G5) (B0-B5)	CLK-DATA	Setup time	tds	3	-	-	ns	
		Hold time	tdh	5	-	-	ns	
	Rise time, Fall time	tdrf	-	-	10	ns	-	
Hsync	Cycle		th	24.0	26.693	30.1	μs	37.463 kHz (typ.)
				1,024			CLK	
	Display period		thd	800			CLK	
	Front-porch		thf	24			CLK	
	Pulse width		thp	12	72	-	CLK	
	Back-porch		thb	-	128	188	CLK	
	Total of pulse width and back-porch		thp + thb	200			CLK	Note2
	CLK- Hsync	Setup time	ths	3	-	-	ns	
		Hold time	thh	5	-	-	ns	
	Rise time, Fall time		thrf	-	-	10	ns	
Vsync	Cycle		tv	16.1	16.683	17.2	ms	59.94 Hz (typ.)
				625			H	
	Display period		tvd	600			H	
	Front-porch		tvf	1			H	
	Pulse width		tvp	1	2	-	H	
	Back-porch		tvb	-	22	23	H	
	Total of pulse width and back-porch		tvp + tvb	24			H	Note2
	Hsync-Vsync	Setup time	tvhs	3	-	-	ns	
		Hold time	tvhh	5	-	-	ns	
	Rise time, Fall time		tvrf	-	-	10	ns	

Note1: Definition of parameters is as follows.

tc = 1CLK, tcd = tch/tc, th = 1H

Note2: Keep tvp + tvb and thp + thb within the table. If it is out of specification, display position will be shifted to right/left side or up/down.

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(b) DE mode

(Note1, Note2, Note3)

Parameter		Symbol	min.	typ.	max.	Unit	Remarks	
CLK	Frequency	1/tc	34.0	38.362	42.0	MHz	26.067 ns (typ.)	
	Duty	tdc	0.4	0.5	0.6	-		
	Rise time, Fall time	tcrf	-	-	10	ns		
DATA (R0-R5) (G0-G5) (B0-B5)	CLK-DATA	Setup time	tds	3	-	-	ns	
		Hold time	tdh	5	-	-		
	Rise time, Fall time	tdrf	-	-	10	ns		
DE	Horizontal	Cycle	th	24.0	26.693	30.1	μs	37.463 kHz (typ.)
				-	1,024	-	CLK	
	Vertical (One frame)	Cycle	tv	16.1	16.683	17.2	ms	59.94 Hz (typ.)
				-	625	-	H	
	CLK-DE	Display period	tvd	600			H	-
				Setup time	tdes	3	-	
				Hold time	tdeh	5	-	
				Rise time, Fall time	tderf	-	-	-
						10	ns	

Note1: Definition of parameters is as follows.

tc = 1CLK, tcd = tch/tc, th = 1H

Note2: Hsync signal (Pin No.3 of CN1) and Vsync signal (Pin No.4 of CN1) are not used inside the product at DE mode.

Do not keep pin open to avoid noise problem.

Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

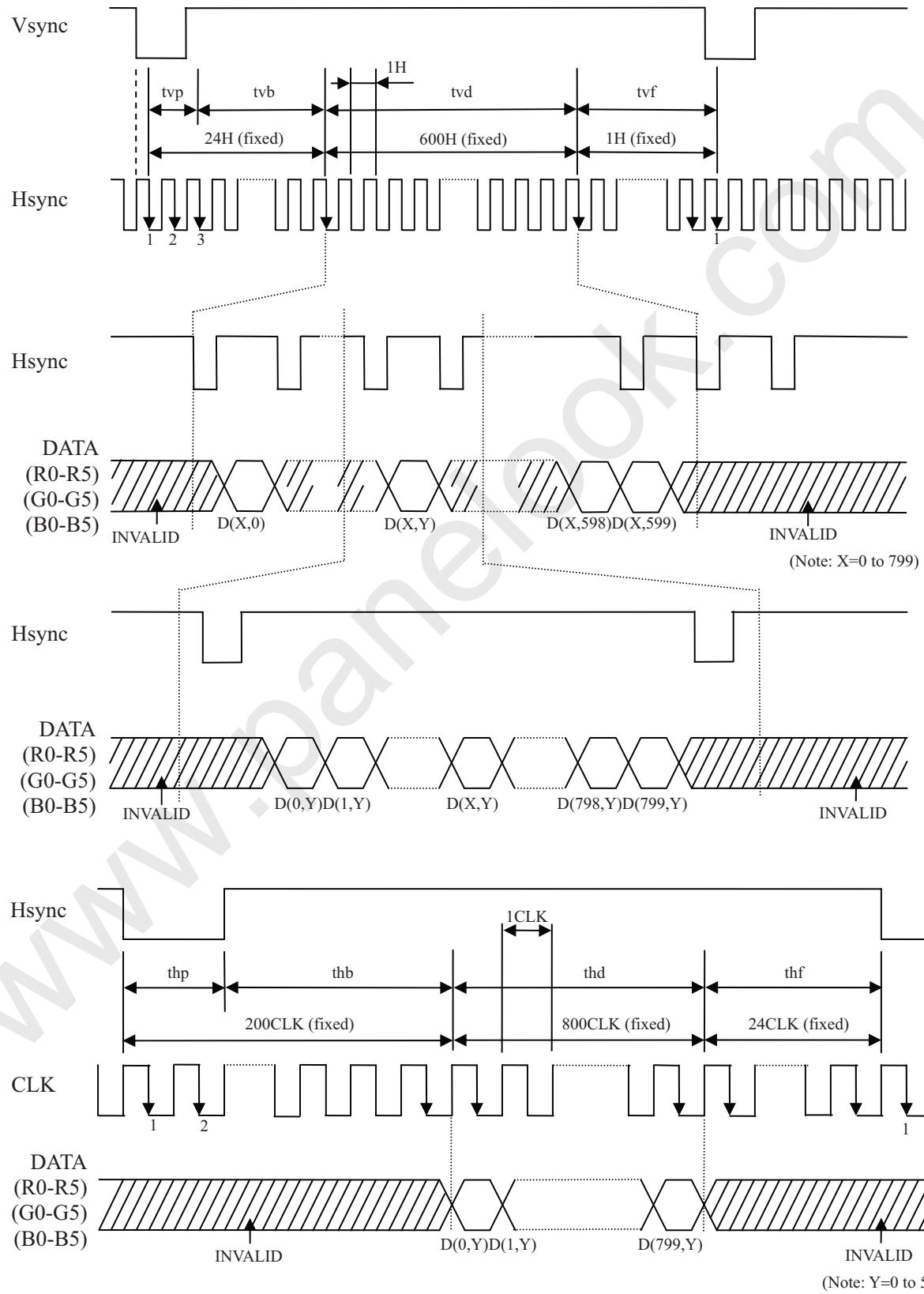
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## 4.9.3 Input signal timing chart

### (a) Fixed mode



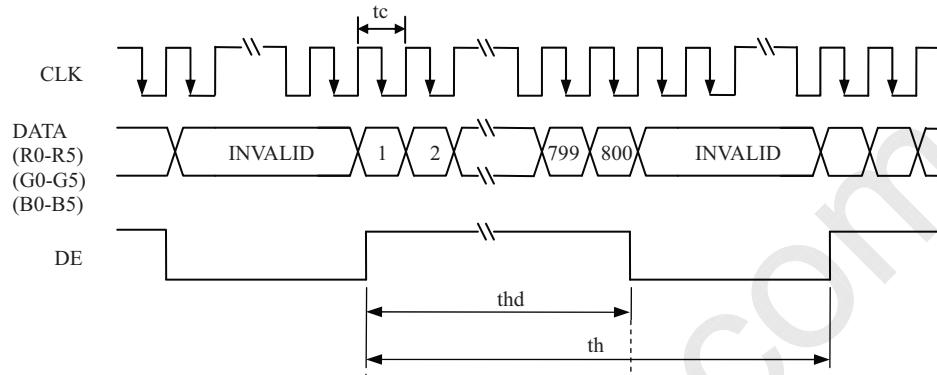
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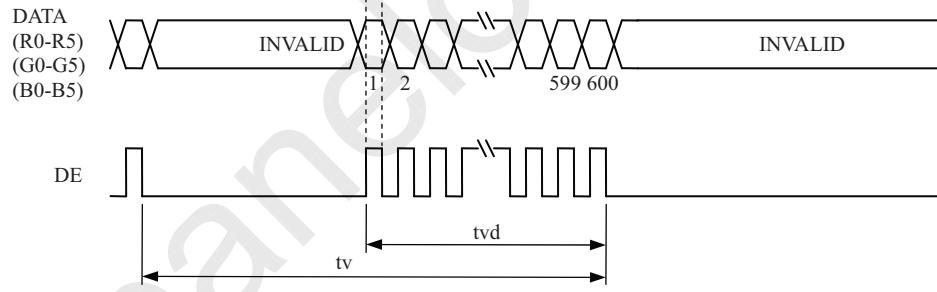
**NL8060BC31-50F**

(b) DE mode

Horizontal timing



Vertical timing

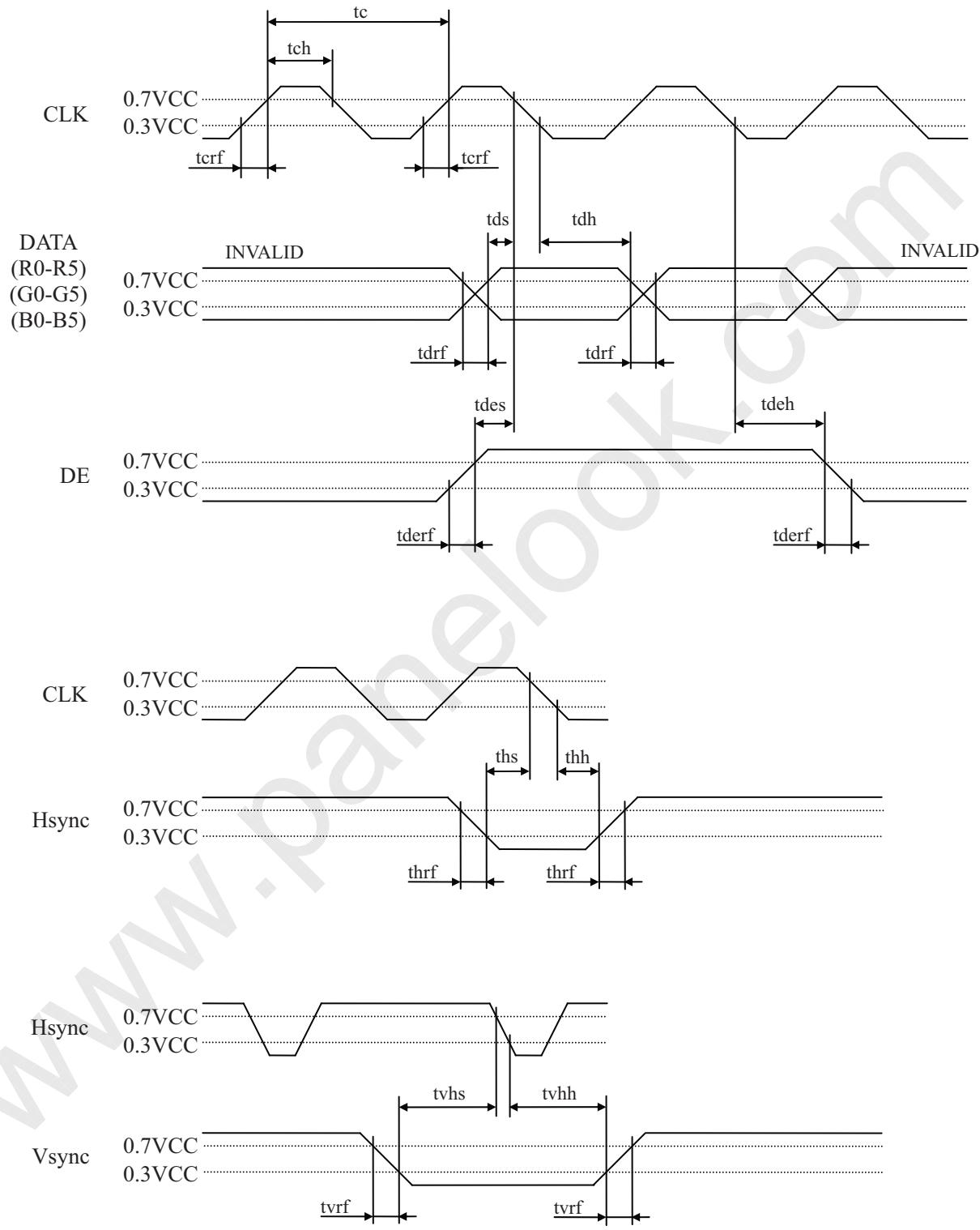


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(c) Common item of Fixed mode and DE mode



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## 4.10 OPTICS

### 4.10.1 Optical characteristics

(Note1, Note2)

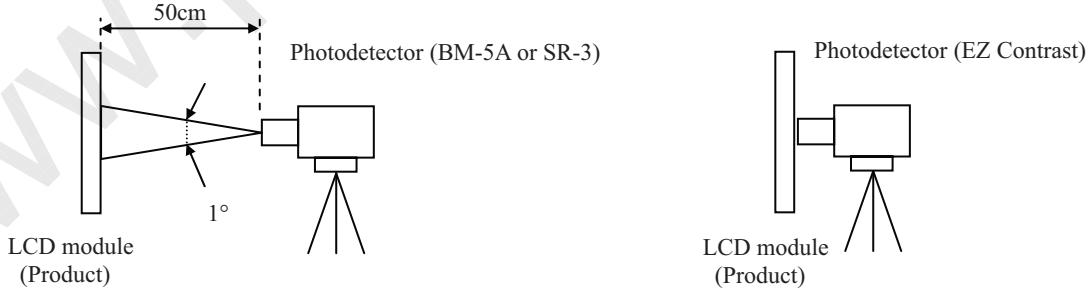
Parameter	Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance	White at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	L	TBD	800	-	cd/m <sup>2</sup>	BM-5A	-
Contrast ratio	White/Black at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	CR	TBD	800	-	-	BM-5A	Note3
Luminance uniformity	White $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	LU	-	1.25	1.4	-	BM-5A	Note4
Chromaticity	White	x coordinate	Wx	0.283	0.313	0.343	-	SR-3 Note5
		y coordinate	Wy	0.299	0.329	0.359	-	
	Red	x coordinate	Rx	-	TBD	-	-	
		y coordinate	Ry	-	TBD	-	-	
	Green	x coordinate	Gx	-	TBD	-	-	
		y coordinate	Gy	-	TBD	-	-	
	Blue	x coordinate	Bx	-	TBD	-	-	
		y coordinate	By	-	TBD	-	-	
Color gamut	$\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$ at center, against NTSC color space	C	35	40	-	%		
Response time	White to Black	Ton	-	TBD	TBD	ms	BM-5A	Note6 Note7
	Black to White	Toff	-	TBD	TBD	ms		
Viewing angle	Right	$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	$\theta R$	70	80	-	$^\circ$	EZ Contrast Note8
	Left	$\theta U = 0^\circ, \theta D = 0^\circ, CR \geq 10$	$\theta L$	70	80	-	$^\circ$	
	Up	$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	$\theta U$	70	80	-	$^\circ$	
	Down	$\theta R = 0^\circ, \theta L = 0^\circ, CR \geq 10$	$\theta D$	70	80	-	$^\circ$	

Note1: These are initial characteristics.

Note2: Measurement conditions are as follows.

Ta= 25°C, VCC= 3.3V, IL= 50 mA/One circuit, Display mode: SVGA, Horizontal cycle= 1/37.463kHz, Vertical cycle = 1/59.94Hz, DPS= Low or Open: Normal scan

Optical characteristics are measured at luminance saturation 20minutes after the product works in the dark room. Also measurement methods are as follows.



Note3: See "4.10.2 Definition of contrast ratio".

Note4: See "4.10.3 Definition of luminance uniformity".

Note5: These coordinates are found on CIE 1931 chromaticity diagram.

Note6: Product surface temperature: TopF= TBD°C

Note7: See "4.10.4 Definition of response times".

Note8: See "4.10.5 Definition of viewing angles".

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## 4.10.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

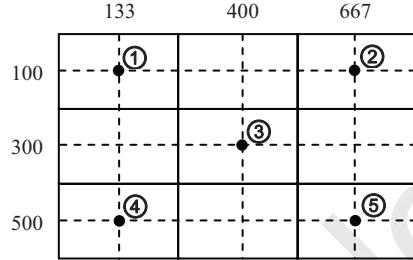
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

## 4.10.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

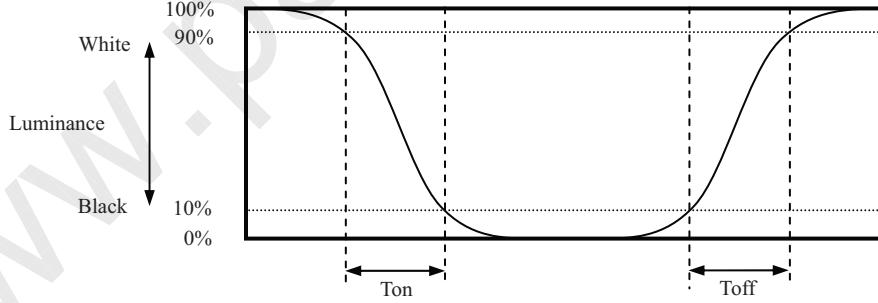
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.

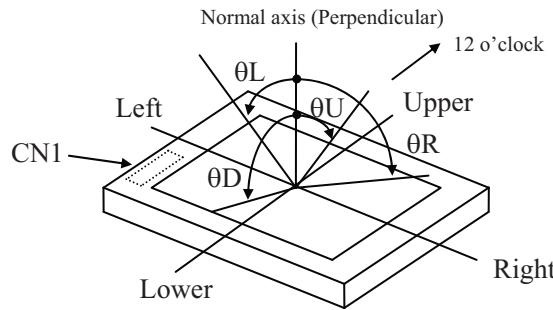


## 4.10.4 Definition of response times

Response time is measured at the time when the luminance changes from "white" to "black", or "black" to "white" on the same screen point, by photo-detector. Ton is the time when the luminance changes from 90% down to 10%. Also Toff is the time when the luminance changes from 10% up to 90% (See the following diagram.).



## 4.10.5 Definition of viewing angles



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## 5. ESTIMATED LUMINANCE LIFETIME

The luminance lifetime is the time from initial luminance to half-luminance.

**This lifetime is the estimated value, and is not guarantee value.**

Condition		Estimated luminance lifetime (Life time expectancy) Note1, Note2, Note3	Unit
LED elementary substance	25°C (Ambient temperature of the product) Continuous operation, IL= 50mA/One circuit	70,000	h
	80°C (Surface temperature at screen) Continuous operation, IL= 50mA/One circuit	TBD	h

Note1: Life time expectancy is mean time to half-luminance.

Note2: Estimated luminance lifetime is not the value for an LCD module but the value for LED elementary substance.

Note3: By ambient temperature, the lifetime changes particularly. Especially, in case the product works under high temperature environment, the lifetime becomes short.

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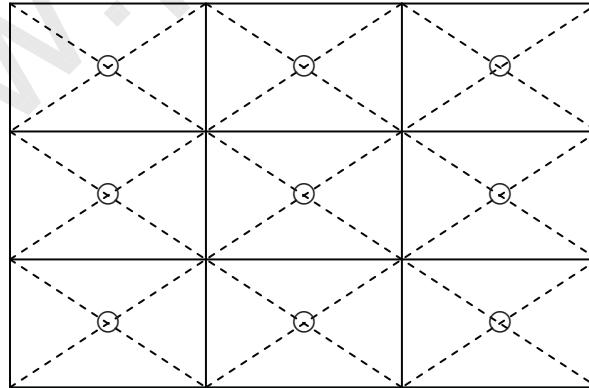
**NL8060BC31-50F**

## 6. RELIABILITY TESTS

Test item	Condition	Judgment	Note1
High temperature and humidity (Operation)	① $60 \pm 2^\circ\text{C}$ , RH= 90%, 240hours ② Display data is black.		
High temperature (Operation)	① $80 \pm 3^\circ\text{C}$ , 240hours ② Display data is black.		
Heat cycle (Operation)	① $-30 \pm 3^\circ\text{C} \dots 1\text{hour}$ $80 \pm 3^\circ\text{C} \dots 1\text{hour}$ ② 50cycles, 4 hours/cycle ③ Display data is black.		
Thermal shock (Non operation)	① $-30 \pm 3^\circ\text{C} \dots 30\text{minutes}$ $80 \pm 3^\circ\text{C} \dots 30\text{minutes}$ ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	No display malfunctions	
ESD (Operation)	① 150pF, 150Ω, $\pm 10\text{kV}$ ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval		
Dust (Operation)	① Sample dust: No. 15 (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval		
Vibration (Non operation)	① 5 to 100Hz, $19.6\text{m/s}^2$ ② 1 minute/cycle ③ X, Y, Z directions ④ 120 times each directions	No display malfunctions	
Mechanical shock (Non operation)	① $539\text{m/s}^2$ , 11ms ② $\pm X, \pm Y, \pm Z$ directions ③ 5 times each directions	No physical damages	

Note1: Display and appearance are checked under environmental conditions equivalent to the inspection conditions of defect criteria.

Note2: See the following figure for discharge points.



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## 7. PRECAUTIONS

### 7.1 MEANING OF CAUTION SIGNS

The following caution signs have very important meaning. **Be sure to read "7.2 CAUTIONS" and "7.3 ATTENTIONS"!**



This sign has the meaning that a customer will be injured or the product will sustain damage if the customer practices wrong operations.



This sign has the meaning that a customer will be injured if the customer practices wrong operations.

### 7.2 CAUTIONS



\* **Do not shock and press the LCD panel and the backlight! There is a danger of breaking, because they are made of glass. (Shock: Equal to or no greater than 539m/s<sup>2</sup> and equal to or no greater than 11ms, Pressure: Equal to or no greater than 19.6 N (φ16mm jig))**

### 7.3 ATTENTIONS



#### 7.3.1 Handling of the product

- ① Take hold of both ends without touching the circuit board when the product (LCD module) is picked up from inner packing box to avoid broken down or misadjustment, because of stress to mounting parts on the circuit board.
- ② When the product is put on the table temporarily, display surface must be placed downward.
- ③ When handling the product, take the measures of electrostatic discharge with such as earth band, ionic shower and so on, because the product may be damaged by electrostatic.
- ④ The torque for product mounting screws must never exceed 0.147N·m. Higher torque might result in distortion of the bezel.
- ⑤ The product must be installed using mounting holes without undue stress such as bends or twist (See outline drawings). And do not add undue stress to any portion (such as bezel flat area). Bends or twist described above and undue stress to any portion may cause display mura.
- ⑥ Do not press or rub on the sensitive product surface. When cleaning the product surface, wipe it with a soft dry cloth.
- ⑦ Do not push or pull the interface connectors while the product is working.
- ⑧ When handling the product, use of an original protection sheet on the product surface (polarizer) is recommended for protection of product surface. Adhesive type protection sheet may change color or characteristics of the polarizer.
- ⑨ Usually liquid crystals don't leak through the breakage of glasses because of the surface tension of thin layer and the construction of LCD panel. But, if you contact with liquid crystal by any chance, please wash it away with soap and water.

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## 7.3.2 Environment

- ① Do not operate or store in high temperature, high humidity, dewdrop atmosphere or corrosive gases. Keep the product in packing box with antistatic pouch in room temperature to avoid dusts and sunlight, when storing the product.
- ② In order to prevent dew condensation occurred by temperature difference, the product packing box must be opened after enough time being left under the environment of an unpacking room. Evaluate the storage time sufficiently because dew condensation is affected by the environmental temperature and humidity. (Recommended leaving time: 6 hours or more with the original packing state after a customer receives the package)
- ③ Do not operate in high magnetic field. If not, circuit boards may be broken.
- ④ This product is not designed as radiation hardened.

## 7.3.3 Characteristics

**The following items are neither defects nor failures.**

- ① Characteristics of the LCD (such as response time, luminance, color uniformity and so on) may be changed depending on ambient temperature. If the product is stored under condition of low temperature for a long time, it may cause display mura. In this case, the product should be operated after enough time being left under condition of operating temperature.
- ② Display mura, flickering, vertical streams or tiny spots may be observed depending on display patterns.
- ③ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ④ The display color may be changed depending on viewing angle because of the use of condenser sheet in the backlight.
- ⑤ Optical characteristics may be changed depending on input signal timings.

## 7.3.4 Other

- ① All GND and VCC terminals should be used without any non-connected lines.
- ② Do not disassemble a product or adjust variable resistors.
- ③ See "REPLACEMENT MANUAL FOR LAMP HOLDER SET", when replacing lamp holder set.
- ④ Pack the product with the original shipping package, in order to avoid any damages during transportation, when returning the product to NEC for repairing and so on.

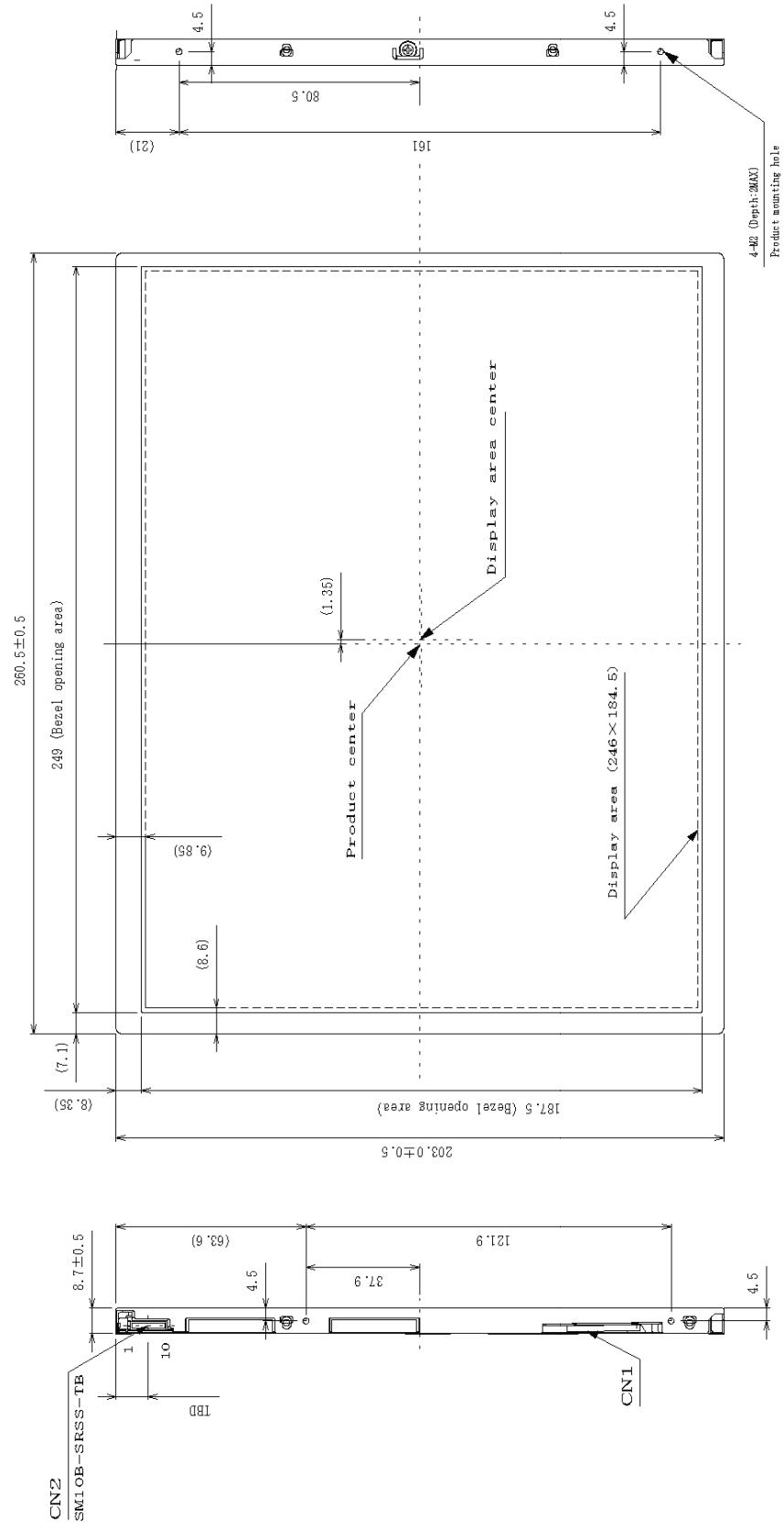
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## 8. OUTLINE DRAWINGS

81 FRONT VIEW

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Note 1: The values in parentheses are for reference.

Note: The values in parentheses are for reference.

**Note2:** The torque for predrill mounting screws must never exceed 0.14 N.m.

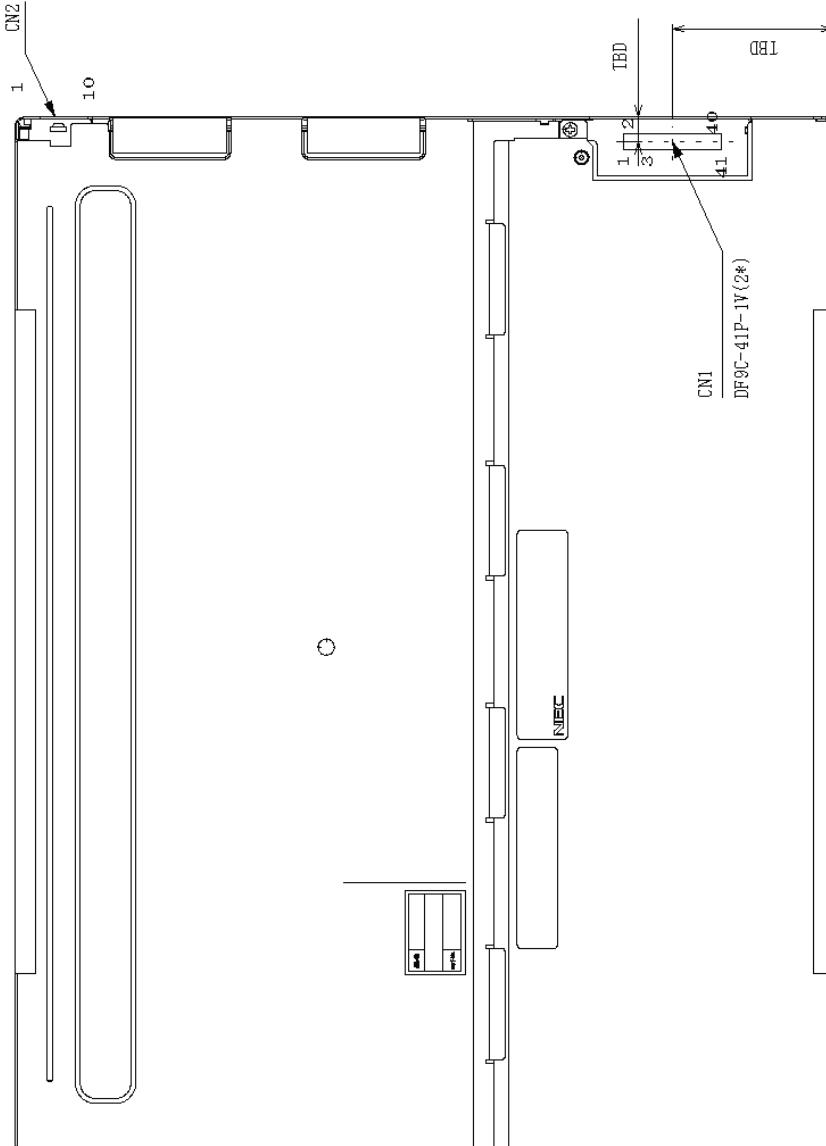
Init. mm

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## 8.2 REAR VIEW



Note1: The values in parentheses are for reference.

Note2: The torque for product mounting screws must never exceed 0.147 N·m.

Note3: Labels stuck on LCD module surface are not included in the module outline.

Unit: mm

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## REVISION HISTORY

*The inside of latest specifications is revised to the clerical error and the major improvement of previous edition. Only a changed part such as functions, characteristic value and so on that may affect a design of customers, are described especially below.*

Edition	Document number	Prepared date	Revision contents and signature									
1st edition	DOD-PP-0991	Apr. 23, 2010	<p><b>Revision contents</b> New issue</p> <p><b>Signature of writer</b></p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center; padding-bottom: 5px;">Approved by</td> <td style="width: 33%; text-align: center; padding-bottom: 5px;">Checked by</td> <td style="width: 33%; text-align: center; padding-bottom: 5px;">Prepared by</td> </tr> <tr> <td style="text-align: center;"></td> <td style="text-align: center;">_____</td> <td style="text-align: center;"></td> </tr> <tr> <td style="text-align: center;">T. OGAWA</td> <td style="text-align: center;">_____</td> <td style="text-align: center;">A. KUMANO</td> </tr> </table>	Approved by	Checked by	Prepared by		_____		T. OGAWA	_____	A. KUMANO
Approved by	Checked by	Prepared by										
	_____											
T. OGAWA	_____	A. KUMANO										